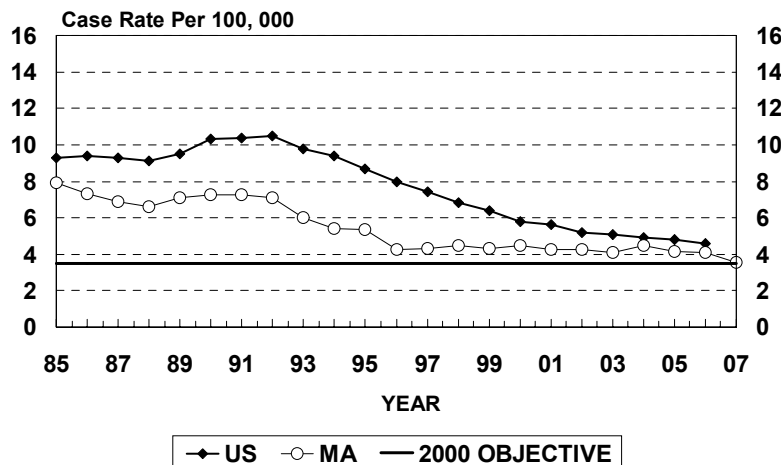


Massachusetts Department of Public Health  
Bureau of Communicable Disease Control  
***Division of Tuberculosis Prevention and Control***

## 2007 Tuberculosis Overview

In 2007, 224 cases (case rate 3.53 per 100,000 population) of active tuberculosis (TB) were reported to and verified by the Massachusetts Department of Public Health, Division of TB Prevention and Control. Following a period of level TB case rates, TB cases declined in 2007 by 14%. For the first time, Massachusetts achieved the year 2000 TB case rate objective of 3.5 per 100,000 set by the Centers for Disease Control and Prevention (CDC).

**Figure 1. United States and Massachusetts Tuberculosis Case Rates, 1985-2007**



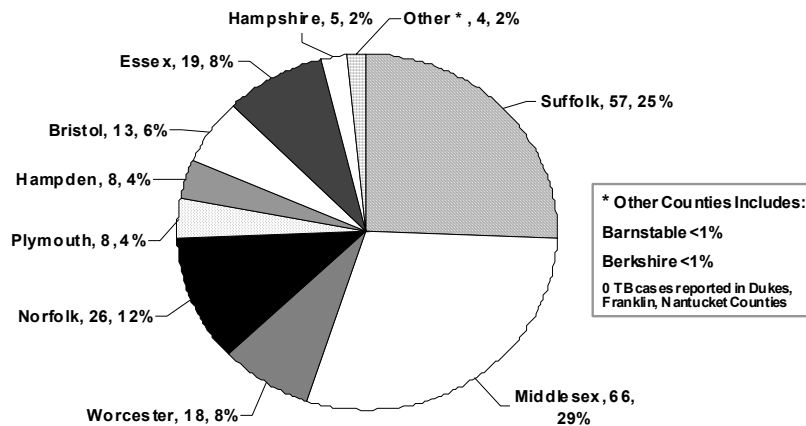
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**Note:** Case rates are based on estimated population for each year. 1990 and 2000 case rates were calculated using 1990 and 2000 U.S census figures. All case rates are per 100,000 population.

Sixty-eight percent of TB in Massachusetts is reported from the 23 largest communities and two additional communities at higher risk of TB (Appendix 1). Although Boston continues to have the highest incidence of TB (49 cases in 2007, case rate 8.3 per 100,000), the proportion of Massachusetts TB cases reported in residents of Boston has declined since 1996 (1996-33%, 2006-22%).

Analysis of TB cases by county of residence reveals that 54% of the cases were reported from two largest counties, Suffolk (25%) and Middlesex (29%). Two counties, Barnstable and Berkshire, had less than 1 percent of the state's TB cases each. Three counties, Dukes, Franklin and Nantucket, reported no TB cases in 2007.

**Figure 2. Confirmed Tuberculosis Cases by County, Massachusetts, 2007 (N = 224)**



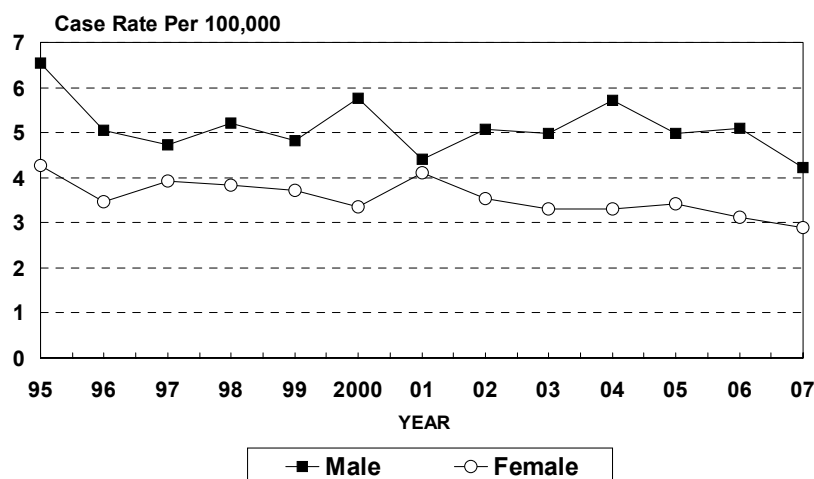
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## **Demographic: Gender, Race/Ethnicity and Age**

### **Gender**

Of the 224 TB cases, 129 (58%) were in males and 95 (42%) in females. There was a greater decrease in the case rate among males compared to females between 2006 and 2007. In 2007, the case rate for males was 4.2 per 100,000 and 2.9 per 100,000 for females.

**Figure 3. Tuberculosis Case Rates by Gender Massachusetts, 1995 - 2007**

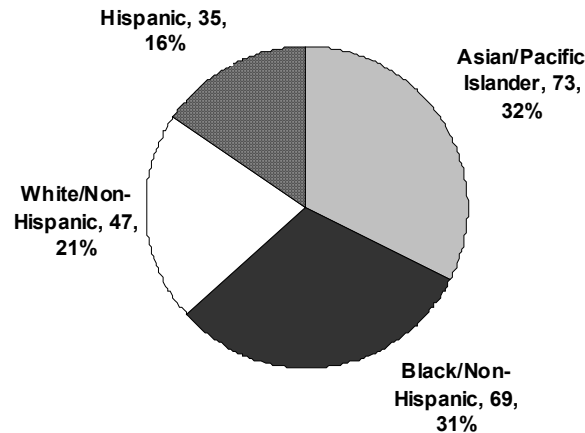


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### **Race/Ethnicity**

The majority of the TB cases in 2007 occurred among persons who were members of minority groups (177 cases, 79%): black (69 cases, 31%), Asian (73 cases, 32%), and Hispanic (35 cases, 16%).

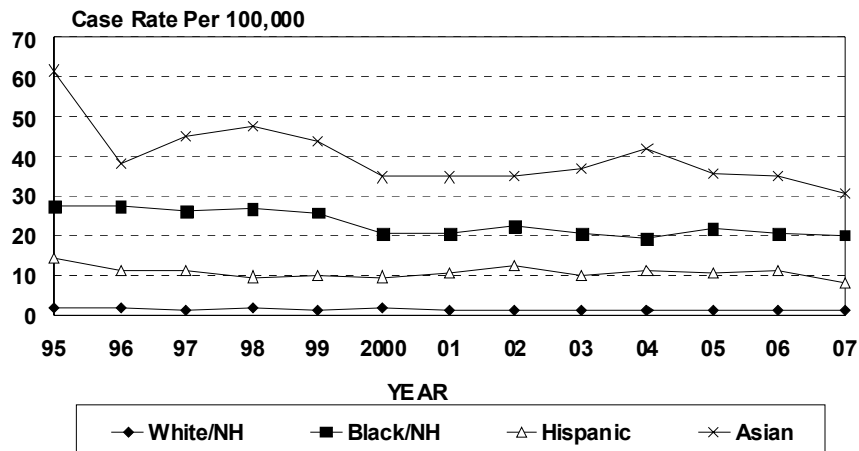
**Figure 4. Tuberculosis Cases by Race/Ethnicity, Massachusetts, 2007 (N=224)**



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For blacks, the case rate has declined 61% from 48.1 in 1991 to 20.1 per 100,000 in 2007. Although Asians continue to have a much higher case rate than any other race/ethnicity group (30.3 per 100,000 in 2007), the case rate among Asians declined 18% since 2004. DEcrease of TB cases in 2007 is seen in all minority groups.

**Figure 5. Tuberculosis Case Rates by Race/Ethnicity, Massachusetts, 1995-2007**



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NH = Non-Hispanic

Compared to white/non Hispanics, blacks were 20.1, Hispanics 8.2 and Asian 30.3 times more likely to have TB disease.

**Table 1. Tuberculosis Case Rates by Race/Ethnicity, Massachusetts, 2007 (N=224)**

Race Ethnicity	No. Cases	Case Rate	Odds Ratio (95% Confidence Interval)
White/NH	47	0.88	1 (0.66 , 1.53)
Black/NH	69	20.09	22.83 (15.60 , 33.79)
Hispanic	35	8.16	9.27 (5.89 , 14.74)
Asian/ Pacific Islander	73	30.34	34.48 (23.66 , 50.80)

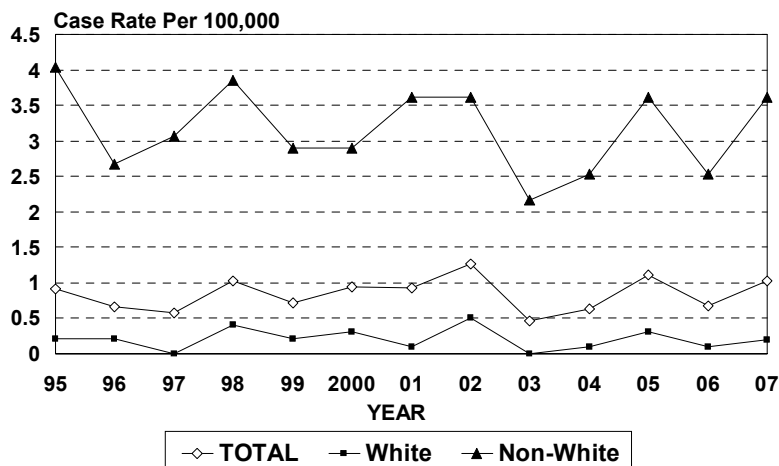
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NH = Non-Hispanic

### Age

In 2007, 12 TB cases (5%) were in children < 15 years of age, of which 10 (83%) were of minority communities. **Despite an overall decline of TB cases, the number of children with TB increase by 50% between 2006 (8 cases) and 2007 (12 cases).** The case rate among minority children in 2007 was 3.6 per 100,000 population, 3 times higher that that of white/non-Hispanic children.

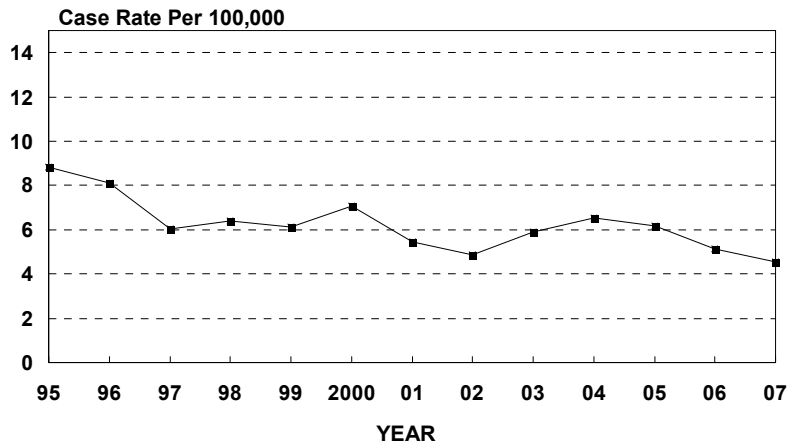
**Figure 6. Rate of Tuberculosis Cases in Children Age < 15 Years By Race Massachusetts, 1995 - 2007**



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In 2007, 39 (17%) TB cases were in persons age 65 years and older. Case rates for this group have declined significantly from 13.6 in 1993 to 4.5 per 100,000 population in 2007.

**Figure 7. Rate of Tuberculosis Cases in Persons Age 65 and Over, Massachusetts, 1995 - 2007**



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#### Age and Race/Ethnicity

Among TB cases reported in 2007, 4 (2%) were in young children less than 5 years of age, 8 (4%) were children ages 5-14, 26 (11%) were young adults ages 15-24, 72 (32%) were between the ages of 25-44, 75 (34%) were between 45-64 and 39 (17%) were age 65 years and older.

**Table 2. Tuberculosis Cases by Age, Race/Ethnicity, Massachusetts, 2007 (N=224)**

Age	White/NH	Black /NH	Hispanic	Asian/Pacific Islander	Total
<5	1 (25%)	2 (50%)	1 (25%)	0	4 (2%)
5-14	1 (10%)	3 (40%)	2 (25%)	2 (25%)	8 (4%)
15-24	0 (0%)	10 (39%)	5 (19%)	11 (42%)	26 (11%)
25-44	10 (14%)	23 (32%)	14 (19%)	25 (35%)	72 (32%)
45-64	18 (24%)	25 (33%)	9 (12%)	23 (31%)	75 (34%)
65+	17 (44%)	6 (15%)	4 (10%)	12 (31%)	39 (17%)
Total	47 (21%)	69 (31%)	35 (16%)	73 (32%)	224 (100%)

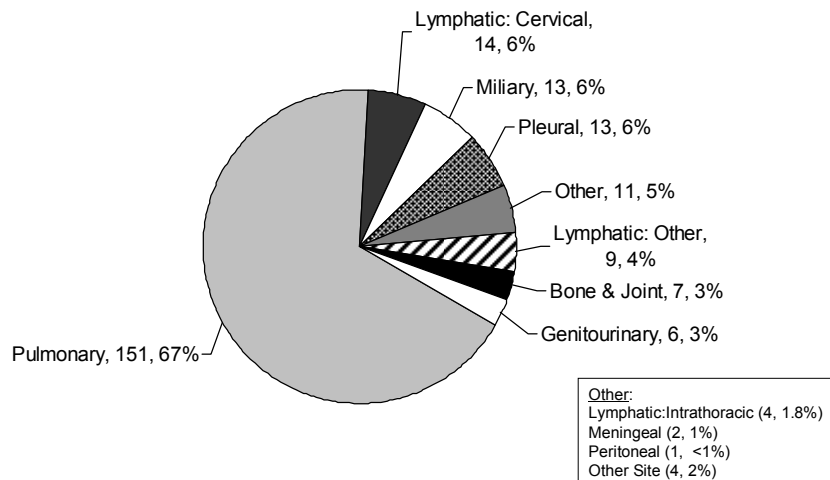
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## Clinical Characteristics

### Site of Disease

In 2007, 151 (67% of 224) people reported with TB presented with the lung as the primary site of disease. This was followed by cervical lymph node - 14 cases (6%), and pleural space - 13 cases (6%).

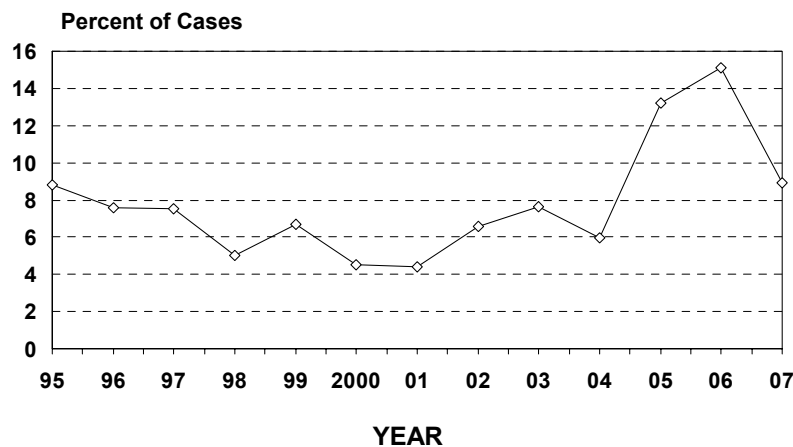
**Figure 8. Percent of Tuberculosis Cases by Primary Disease Site  
Massachusetts, 2007 (N=224)**



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In 2007, 20 TB cases (9%) had multiple sites of disease, a significant decrease from 2006.

**Figure 9. Percent of Tuberculosis Cases with Multiple Sites of Disease  
Massachusetts, 1995 – 2007**

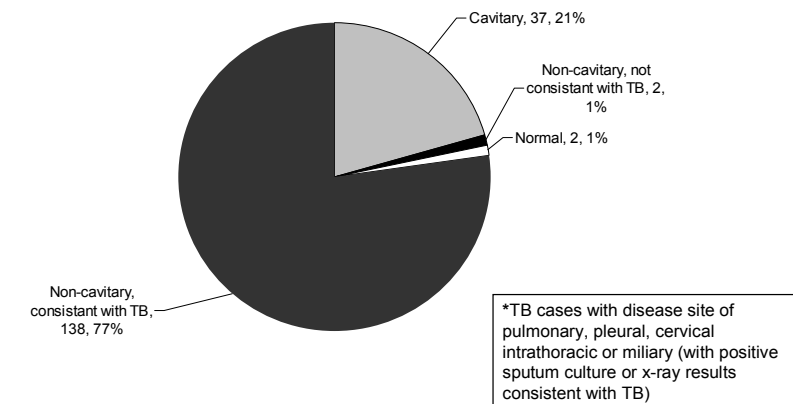


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### Chest Radiography Results

Of the 224 TB cases, 179 (80%) had pulmonary involvement. Of those, 138 (77%) presented with non-cavitary pulmonary disease at time of diagnosis. Thirty-seven cases (21%) presented with cavitary disease, 2 cases (1%) had a report of an abnormal chest x-ray not consistent with TB and 2 cases (1%) had a report of a normal chest x-ray.

**Figure 10. Pulmonary\* Tuberculosis by Chest X-ray Results  
Massachusetts, 2007 (N=179)**

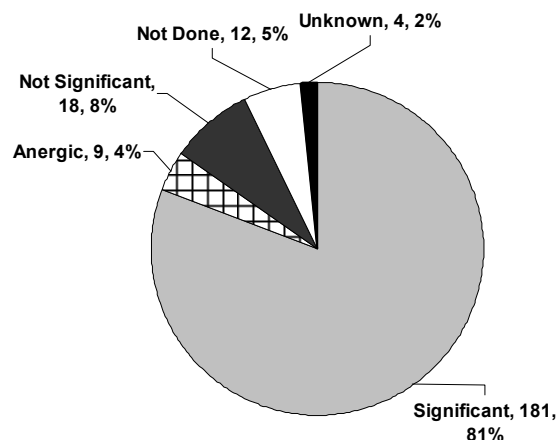


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### Skin Test Results

Of the 224 TB cases, 181 (81%) had positive tuberculin skin test results recorded, 9 cases (4%) were documented to be anergic, 18 cases (8%) had negative results, 4 cases (2%) had unknown results, and 112 cases (5%) did not have skin testing done.

**Figure 11. Tuberculosis Cases by Tuberculin Skin Test Results, Massachusetts, 2007 (N=224)**

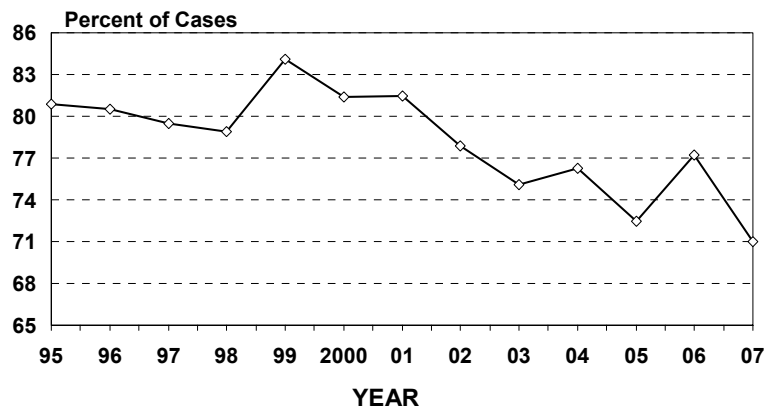


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## Bacteriologic Confirmation

In 2007, 159 (71%) of the 224 TB cases were bacteriologically confirmed. This represents a bacteriologically substantiated incidence rate of 2.5 per 100,000 population. **There has been a decline in the percent of bacteriologically confirmed TB cases from 84% in 1999 to 77% in 2006 and 71% in 2007.** It is only from positive cultures that drug susceptibility testing can be performed.

**Figure 12. Percent of Bacteriologically Confirmed TB Cases  
Massachusetts, 1995 – 2007**



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Of the 159 bacteriologically confirmed cases, drug susceptibility tests were performed on isolates from all 159 (100%) cases. Twenty-four (15%) of the 159 were isolates were resistant to one or more anti-tuberculosis drug. Twelve cases (50% of 24 cases or 8% of 159 cases) had isolates resistant to isoniazid (INH), either alone or in combination with other agents. In 2007, there was 1 MDR-TB case (resistant to INH and Rifampin (RIF), with or without resistance to any other drugs). A review of bacteriology data from 1993 to 2007, found no XDR-TB cases (defined as an MDR-TB case, with additional resistance to any fluoroquinolone and at least one injectable second-line drugs such as amikacin, kanamycin or capreomycin).



**Table 3. Tuberculosis Drug Resistance  
Massachusetts, 2007**

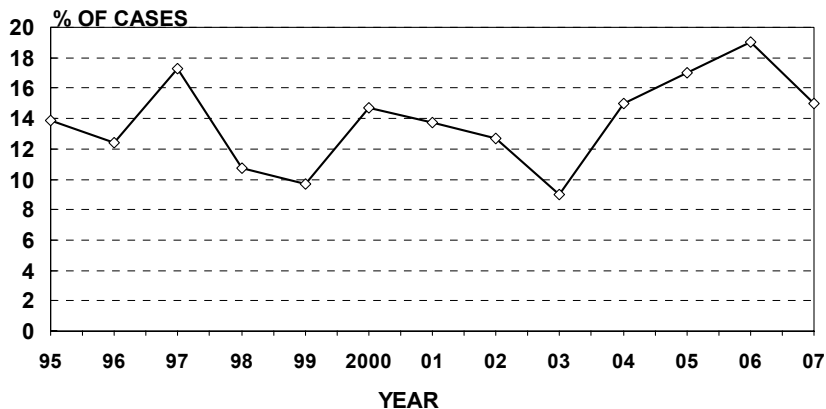
<b>TB Cases</b>	<b>(N=224)</b>
Bacteriologically Confirmed Cases*	159 (71% of 224)
Drug Susceptibility tests performed	159 (100% of 159)
Confirmed Any Drug Resistance	24 (15% of 159)
Resistant To Isoniazid (Alone or in Combination with Other)	12 (8% of 159)
Resistant to at least Isoniazid and Rifampin (MDR-TB)	1 (<1% of 159)
Resistant to at least Isoniazid and Rifampin, plus any fluoroquinolone and at least one of the three injectable second-line drugs (XDR-TB)	None
* Bacteriologically substantiated Incidence of 2.5 per 100,000 population	

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Note: drug resistance is defined as greater than 1 percent bacterial population resistance to any concentration of that drug. Multi-drug resistance is defined as resistance to isoniazid (INH) and rifampin (RIF), with or without any other resistance.

Between 2003 and 2006, the proportion of cases caused by *M. tuberculosis* resistant to anti-tuberculosis drugs increased from 9% in 2003 to 19% in 2006. The highest reported drug resistance rate since 1991 occurred in 2006. In 2007, the rate of drug resistance declined to 15%, a similar rate observed prior to 2003.

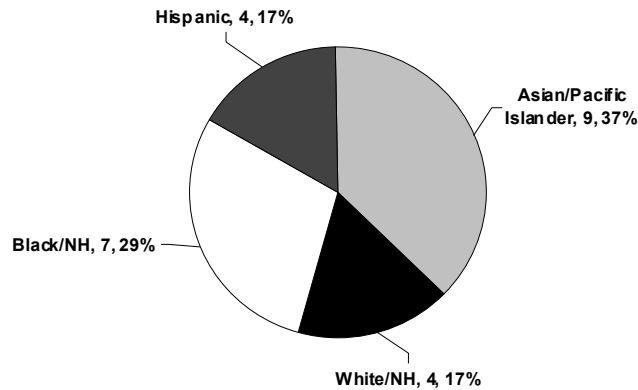
**Figure 13. Percent of Bacteriologically Confirmed  
TB Cases With Drug Resistant Isolates  
Massachusetts, 1995 - 2007**



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The majority of the drug resistant isolates were in Asian TB cases 9 (37%); then blacks, 7 cases (29%); whites, 4 cases (17%); and Hispanics, 4 cases (17%).

**Figure 14. Drug Resistant Tuberculosis Cases by Race/Ethnicity Massachusetts 2007 (N=24)**

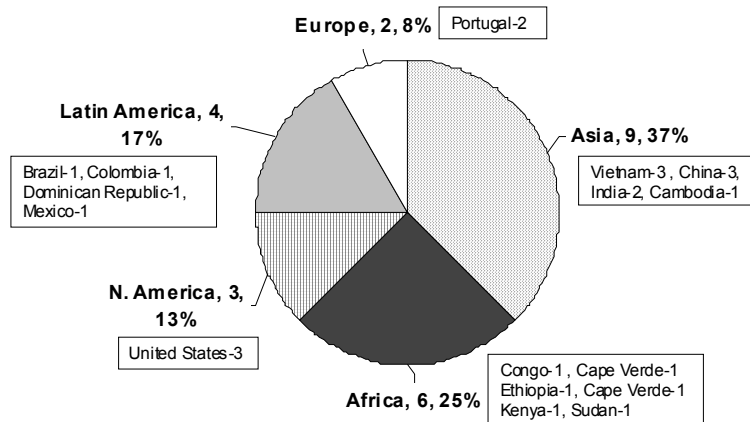


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NH = Non Hispanic

Of the 24 TB cases with drug resistant *M. tuberculosis* isolates, 21 (88%) were in individuals born **outside** the United States. Countries of origin included: Vietnam - 3 cases (12%) and China - 3 cases (12%). The remaining 15 (63%) cases were from 13 different countries.

**Figure 15. Drug Resistant Cases by Place of Birth, Massachusetts, 2007 (N=24)**

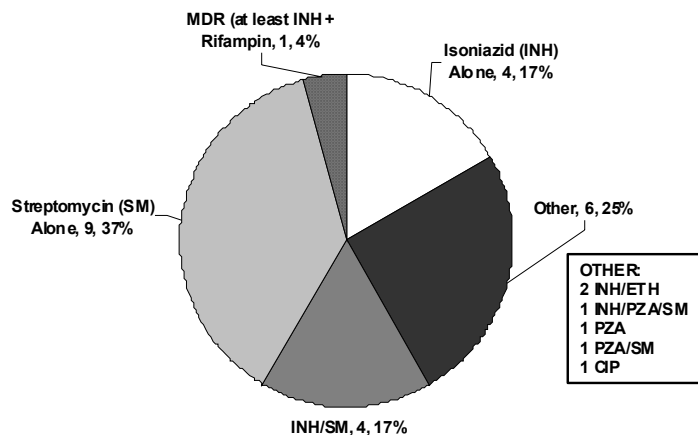


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24 cases from 16 countries

Of the 24 TB cases with drug resistant *M. tuberculosis*, isolates from 4 cases (17%) were resistant to isoniazid (INH) alone, 4 cases (17%) were resistant to INH and streptomycin (SM) and 9 cases (37%) were resistant to SM alone. In 2007, there was 1 case (4%) with multi-drug resistant TB (MDR-TB). The remaining 6 cases (25%) were due to *M. tuberculosis* resistant to other combinations of TB drugs.

**Figure 16. Tuberculosis Cases By Drug Resistance Pattern  
Massachusetts, 2007 (N = 24)**



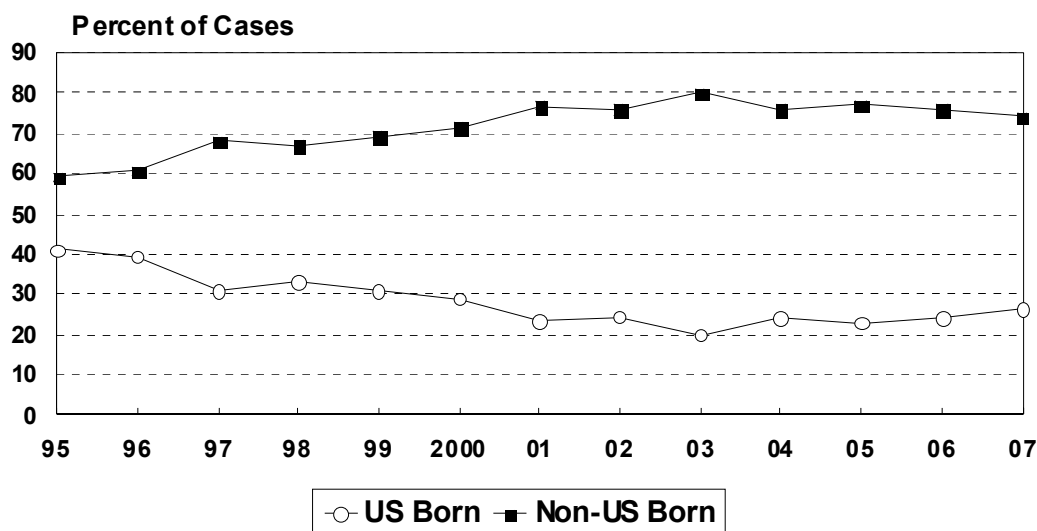
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## Higher Risk Group Profile

### Cases in Non-U.S. Born Persons

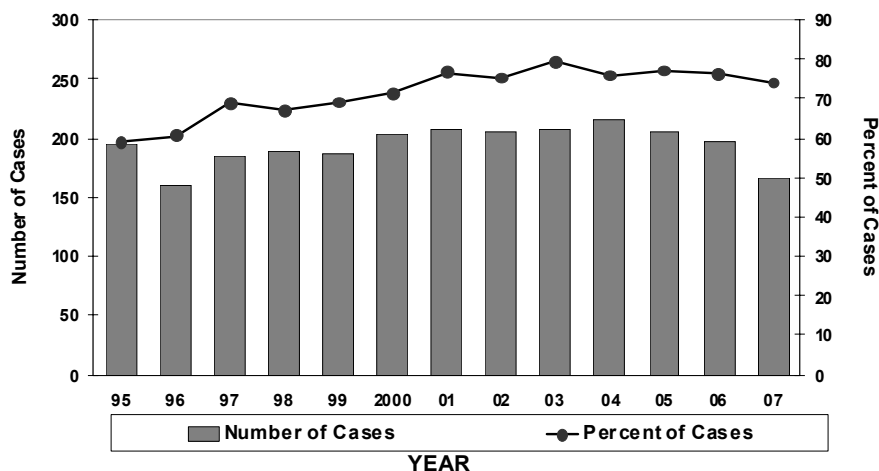
The non-U.S. born (defined as persons born outside the United States and its territories) remains the group at highest risk for TB disease in Massachusetts. Of the 224 TB cases in 2007, 166 (74%) occurred in persons not born in the U.S. Over the years, non-U.S. born persons have accounted for an increasing proportion of the TB cases in Massachusetts, from 35% in 1984, 51% in 1991, and 74% in 2007. However, in the past 2 years there has been a decline in the number of TB cases among the non-U.S. born.

**Figure 17. Percent of Tuberculosis Cases by Place of Birth, Massachusetts, 1995 - 2007**



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**Figure 18. Trends in TB Cases in Non-US Born Persons, Massachusetts, 1995 - 2007**



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Analysis of the 2007 TB cases by world regions reveals that the majority of the non-U.S. born TB cases are from Asia, 68 cases (30%), specifically South Eastern Asia. Fifty-five cases (25%) were from Latin America particularly from the Caribbean. Thirty-three (15%) of the TB cases were from Africa, mostly from the Eastern and Western regions.

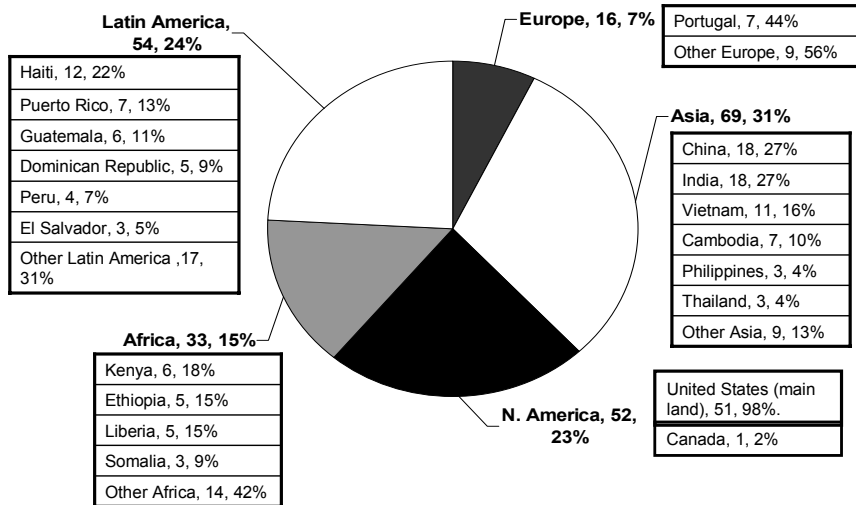
**Figure 19. Tuberculosis Cases; Place of Birth by World Regions\* Massachusetts, 2007 (N=224)**

<b>North America 52 (24%)</b>	<b>Latin America 54 (24%)</b>	<b>Africa 33 (15%)</b>	<b>Asia 69 (31%)</b>	<b>Europe 16 (7%)</b>
[United State main land,- 51(23%), and Canada -1(<1%)]	<u>Caribbean</u> <b>27 (13%)</b> [Haiti -12 cases, Puerto Rico -7, Dominican Republic -5, Jamaica -3]	<u>Eastern Africa</u> <b>18 (8%)</b> [Kenya -6 cases, Ethiopia -5, Somalia -3, Uganda -2 , Malawi -1, Tanzania -1]	<u>Eastern Asia</u> <b>21 (9%)</b> [China - 18 cases, N. Korea -1, S. Korea -1, Hong Kong -1]	<u>Eastern Europe</u> <b>3 (1%)</b> [Ukraine -1, Russian Federation - 2]
	<u>Central America</u> <b>10 (4%)</b> [Guatemala -6, El Salvador - 3, Mexico -1]	<u>Middle/North Africa</u> <b>5 (2%)</b> [Cameroon -2, Congo -2, Sudan -1]	<u>South Central Asia</u> <b>20 (9%)</b> [India -18, Pakistan -1, Maldives -1]	<u>Northern Europe</u> <b>2 (&lt;1%)</b> [Ireland -1, United Kingdom-1]
	<u>South America</u> <b>17 (8%)</b> [Brazil -6, Peru - 4, Colombia -2, Ecuador -2, Uruguay -2, Venezuela -1]	<u>Southern Africa</u> <b>0 (0%)</b>	<u>South Eastern Asia</u> <b>26(12%)</b> Vietnam-11, Cambodia-7, Thailand-3, Philippines -3, Myanmar -2,	<u>Southern Europe</u> <b>11 (5%)</b> [Portugal -7, Bosnia / Herzegovina-2, Greece-1, Croatia-1]
		<u>Western Africa</u> <b>10 (4%)</b> [Liberia - 5, Guinea-2, Cape Verde -2, Sierra Leone - 1]	<u>Western Asia</u> <b>2 (1%)</b> [Kuwait -1, Syria -1]	<u>Western Europe</u> <b>0</b>

\* United Nations World Macro Regions <http://www.un.org/depts/dhl/maplib/worldregions.htm>

Sixty percent of the 166 non-U.S. born persons with TB in 2007 were from 11 countries: China and India each accounted for 18 cases (11%) followed by Haiti - 12 cases (7%), Vietnam -11 cases (7%), Cambodia -7 cases (4%), Portugal - 7 cases (5%), Guatemala - 6 cases (4%), Kenya - 6 cases (4%). The Dominican Republic, Ethiopia and Liberia each accounted for 5 cases (3%). The remaining 66 cases (40%) included in people from 37 different countries.

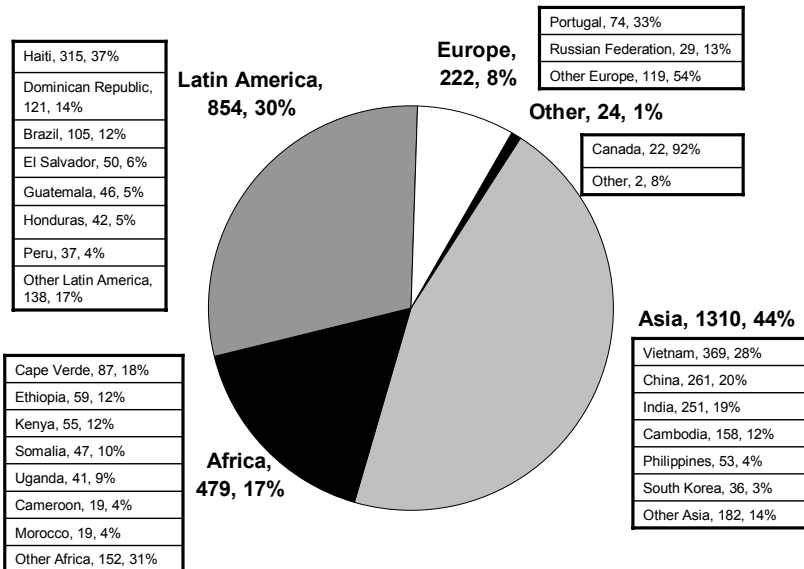
**Figure 20. Tuberculosis Cases;  
Place of Birth by World Regions  
Massachusetts, 2007(N=224)**



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Country of origin data and the date of entry into the U.S. were collected consistently starting in 1993. Between 1993 and 2007: 2,892 non-U.S. born TB cases were reported in Massachusetts: of those, the majority were from Asia - 1,310 cases (44%), Latin America - 854 (30%), Africa - 479 cases (17%) and Europe - 222 cases (8%).

**Figure 21. Place of Birth of Non-US Born Massachusetts TB Cases, by World Region, 1993-2007 (N=2,892 )**



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**Table 4. Country of Origin for Non-US Born Cases  
Massachusetts, 1993 – 2007 (2,892)**

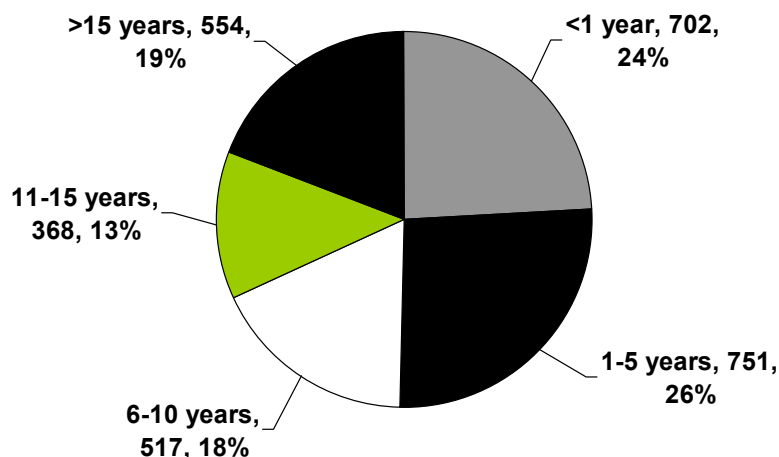
Country	Number	Percent
Vietnam	369	13%
Haiti	315	11%
China	261	9%
India	251	9%
Cambodia	158	6%
Dominican Republic	121	4%
Brazil	106	4%
Cape Verde	87	3%
Portugal	74	3%
Ethiopia	59	2%
Kenya	55	2%
111 different countries	1,036	36%

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US Born cases includes Puerto Rico

For many populations, the risk of developing TB disease is highest during the first few years after arrival to the U.S. Analysis of the 2,892 TB cases in the non-U.S. born, with date of entry information available, indicates that 1,453 cases (50%) developed TB disease within 5 years of arriving in the U.S.

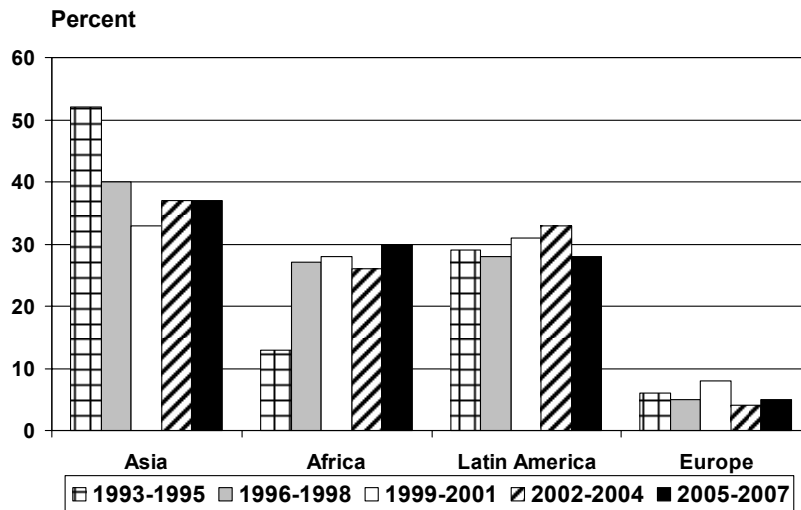
**Figure 22. Time Interval Between Arrival in  
the US and TB Diagnosis Among Non-US  
Born Cases, Massachusetts, 1993 – 2007  
(N=2,892)**



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Analysis of 1,453 non-U.S. born TB cases who developed TB within 5 years of arrival indicates that over time, the proportion of persons from Latin America and Europe who breakdown with TB soon after arrival have remained stable. For Asians with TB, those breaking down with TB within 5 years have declined from 52% between 1993-1995 to 37% seen in 2005-2007. **However, for Africans, the proportion of persons who are diagnosed with TB soon after arrival has increased greatly from 13% seen in 1993-1995 to 30% seen between 2005-2007.**

**Figure 23. Percent of Non-US born Cases Diagnosed with TB within 5 years of Arrival to the US by Continent of Origin, Massachusetts, 1993 – 2007 (N=1,453)**



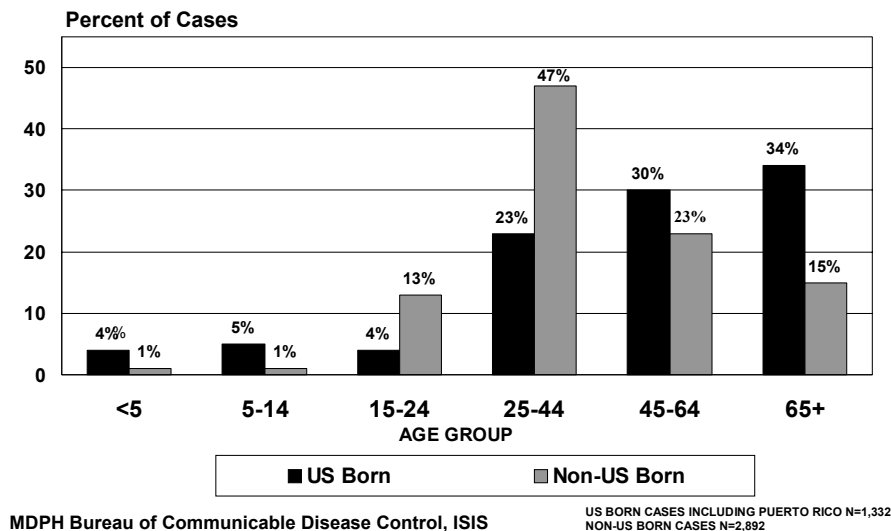
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#### Non-U.S. Born vs. U.S born

People reported with TB who were non-U.S. born were more likely to be between 25 - 44 years old (47% vs. 23%). Young children were more likely to be U.S. born. However, it is possible that many parents of the U.S. born children are non-U.S. born. Information on the country of origin of the parents is not available. A greater proportion of those age 65 years and older were U.S.-born (35% vs. 15%)

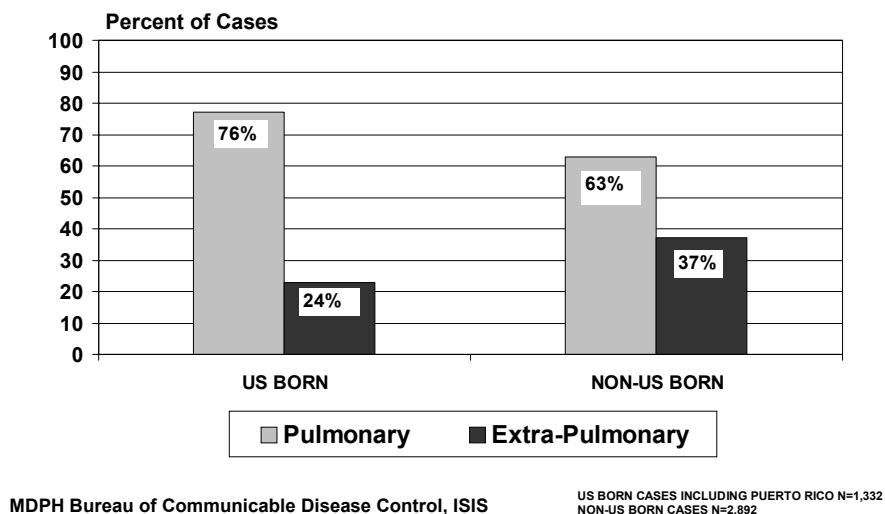


**Figure 24. Percent of Non-US Born and US Born Cases by Age Group  
Massachusetts, 1993 - 2007 (N=4,224)**



TB in the U.S. born was more likely to be pulmonary disease than in non-U.S. born cases (76% vs. 63%).

**Figure 25. Percent of Non-US Born and US Born Cases by Site of Disease  
Massachusetts, 1993-2007 (N=4,224)**



### Cases in the Homeless Population

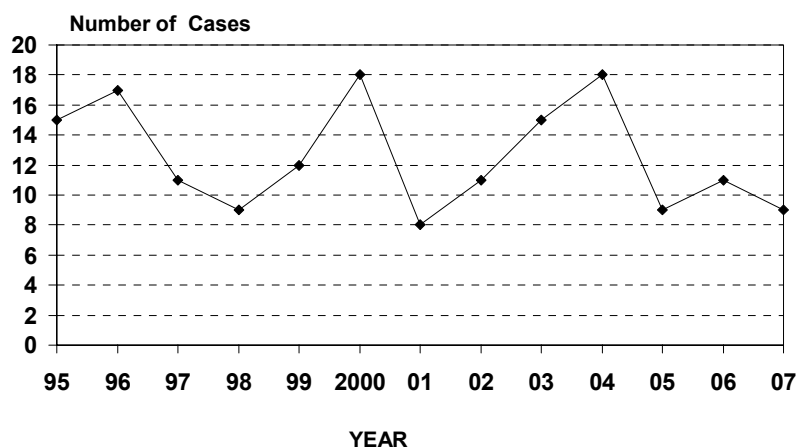
A homeless person is defined as one who lacks a fixed, regular and adequate night time residence. This includes a person who resides in a shelter, welfare hotel, on the street, or in a single room occupancy hotel, and who is not paying rent, does not own a home and is not steadily living with relatives or friends.

Of the 224 cases of TB reported in 2007, 9 cases (4%, case rate 28.0 per 100,000 estimated homeless) were reported to have been homeless. Among the 9 homeless cases, 7 (78%) were reported in the City of Boston.

Note: data reported prior to 1993 for homeless was limited to persons who were homeless at time of diagnosis. In 1993, the CDC revised the definition of homelessness to include persons who had been homeless within a year prior to diagnosis.

The 2000 census indicates that there were 6,210 homeless persons in Boston. The Massachusetts Bureau of Health Statistics, Research and Evaluation estimates that there are approximately 31,100 homeless persons statewide. Case rates were calculated based on these figures.

**Figure 26. Tuberculosis Cases Among the Homeless, Massachusetts, 1995 - 2007**



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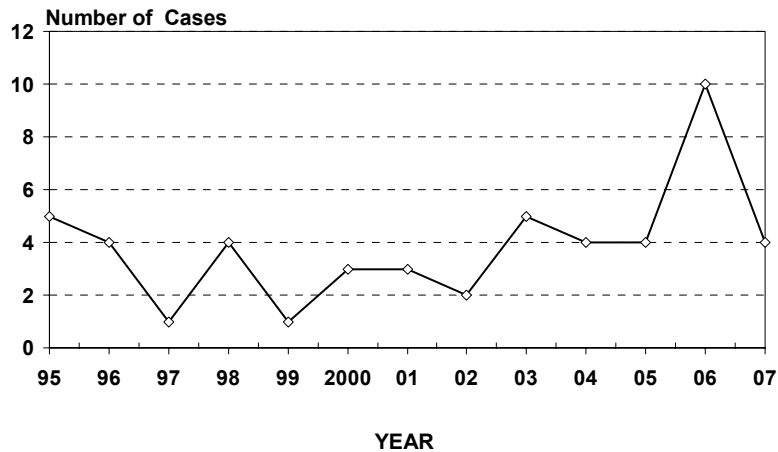
### Cases in Correctional Facilities

Since 1995, the numbers of TB cases diagnosed in persons residing in correctional facilities had remained constant, with no more than 5 cases per year (1995 - 5 cases, 1998 - 4 cases, 2003 - 5 cases). In 2006, 10 cases (4%, case rate 41.5 per 100,000 incarcerated) were diagnosed in persons held in Massachusetts's correctional facilities. During that year, a cluster of TB cases occurred related to a single facility. In 2007, 4 cases (2%, case rate 16.6 per 100,000 incarcerated) were diagnosed in correctional facilities.

Note: The Massachusetts Department of Corrections estimates the average inmate census at

10,528 for state correctional facilities and at 13,542 for county correctional facilities.  
[http://www.mass.gov/Eeops/docs/doc/research\\_reports/4th\\_06\\_overcrowding.pdf](http://www.mass.gov/Eeops/docs/doc/research_reports/4th_06_overcrowding.pdf)

**Figure 27. Number of Tuberculosis Cases in Correctional Facilities Massachusetts, 1995 - 2007**

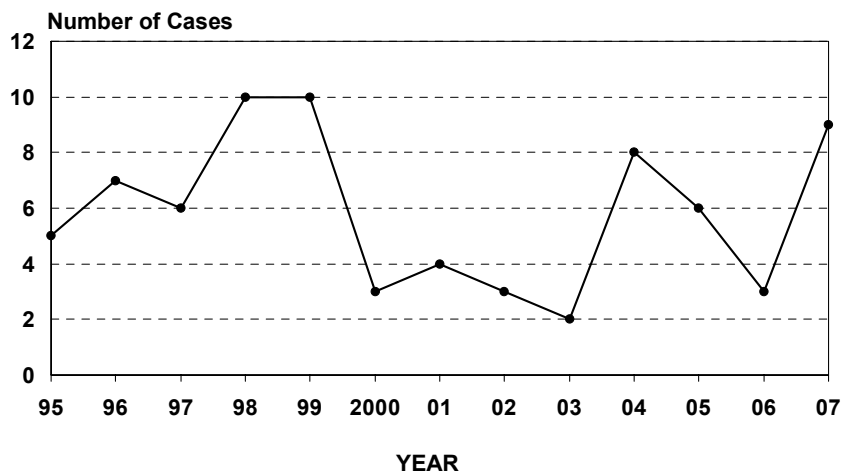


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Cases in Long Term Care Facilities

In 2007, 9 cases (4%) of TB were reported in persons residing in long term care facilities at time of diagnosis - 7 in nursing homes and 2 in other residential facilities.

**Figure 28. Tuberculosis Cases in Long Term Care Facilities, Massachusetts, 1995 - 2007**

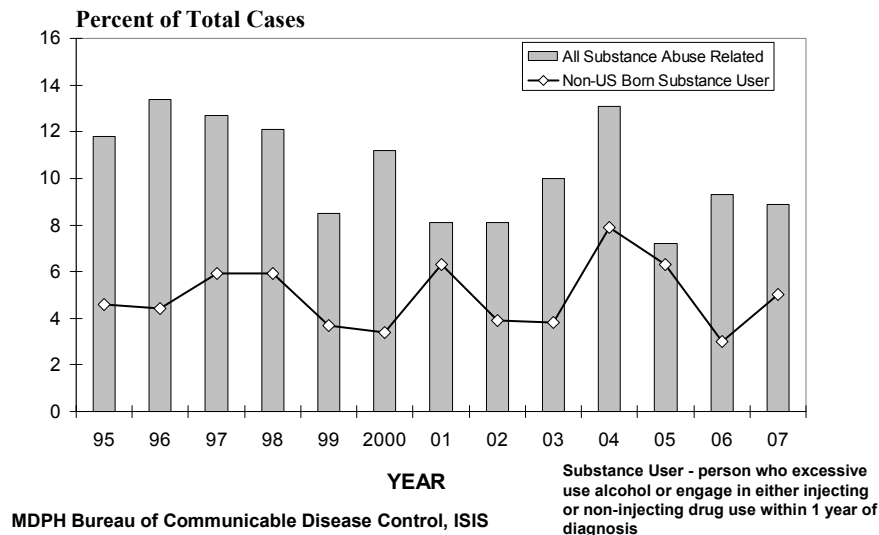


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### Cases Among those who Abuse Substances

In 2007, 20 cases (9%) of TB cases were reported as substance users (defined as a person who has excessive use of alcohol or who engaged in either injecting or non-injecting drug use within 1 year of diagnosis with TB). Eleven (55%) of the 20 substance users were non-U.S. born. Thirteen of the 20 cases engaged only in alcohol use (65%), 4 cases (20%) engaged only in injecting/non-injecting drug use and 3 cases (15%) engaged in both.

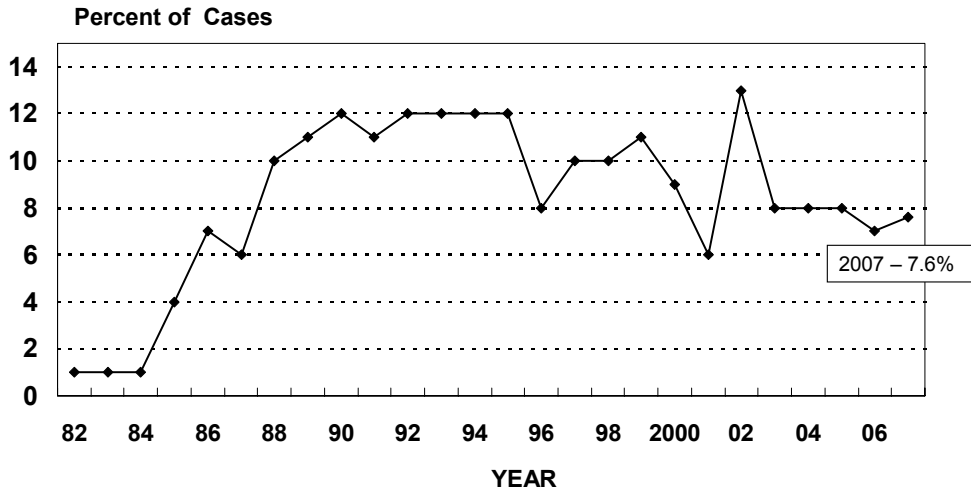
**Figure 29. Percent of Tuberculosis Cases with Substance Abuse, Massachusetts, 1995 - 2007**



### **TB/AIDS Cases**

Matches of the TB registry to the AIDS registry have taken place annually since 1992. In 1993, the AIDS case definition was revised to include anyone with HIV infection with TB disease at any site. Between 1982 and 2007, 722 TB/AIDS cases were identified. In 2007, 17 TB cases (7.6%) were identified as being co-infected with HIV.

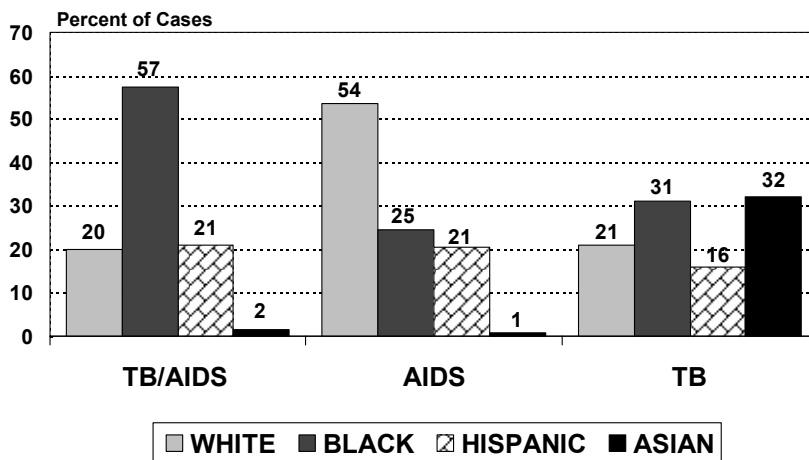
**Figure 30. Percent of TB Cases Diagnosed With AIDS  
Massachusetts, 1982 - 2007  
(TB/AIDS = 722)**



MDPH Bureau of Communicable Disease Control, ISIS

Minority group members accounted for the majority of the TB/AIDS cases (578 cases, 80%). When compared to the reported AIDS cases and TB cases, a greater proportion of TB/AIDS cases were black (25% of AIDS cases and 31% of TB, 57% of TB/AIDS).

**Figure 31. TB/AIDS , AIDS\*, and TB\*\*  
Cases by Race, Massachusetts, 1982 – 2007  
(TB/AIDS = 722)**



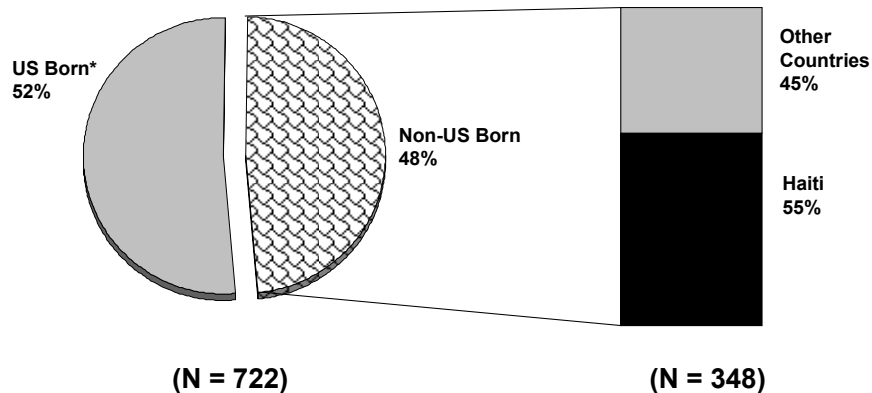
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\*AIDS Excludes Those Diagnosed With TB

\*\*TB Cases as of 2007

Of the 722 TB/AIDS cases reported between 1982 and 2007, 348 (48%) were persons born outside of the U.S. and its territories. The majority of the non-U.S. born cases (55%) were born in Haiti.

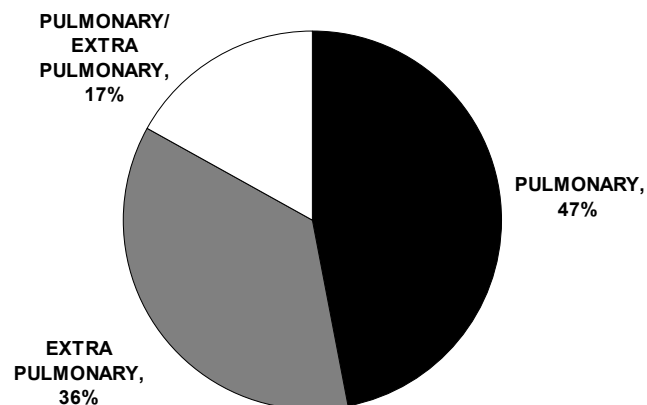
**Figure 32. Percent TB/AIDS Cases by Place of Birth  
Massachusetts, 1982 – 2007  
(TB/AIDS = 722)**



MDPH Bureau of Communicable Disease Control, ISIS    \*US Born includes US Dependencies

Analysis of TB disease site among TB/AIDS cases demonstrates that 339 (47%) had only pulmonary involvement, 259 (36%) had only extra-pulmonary disease and 124 (17%) had both pulmonary and extra-pulmonary involvement.

**Figure 35. TB/AIDS Cases by Site of TB Disease,  
Massachusetts, 1982 – 2007  
(TB/AIDS = 722)**

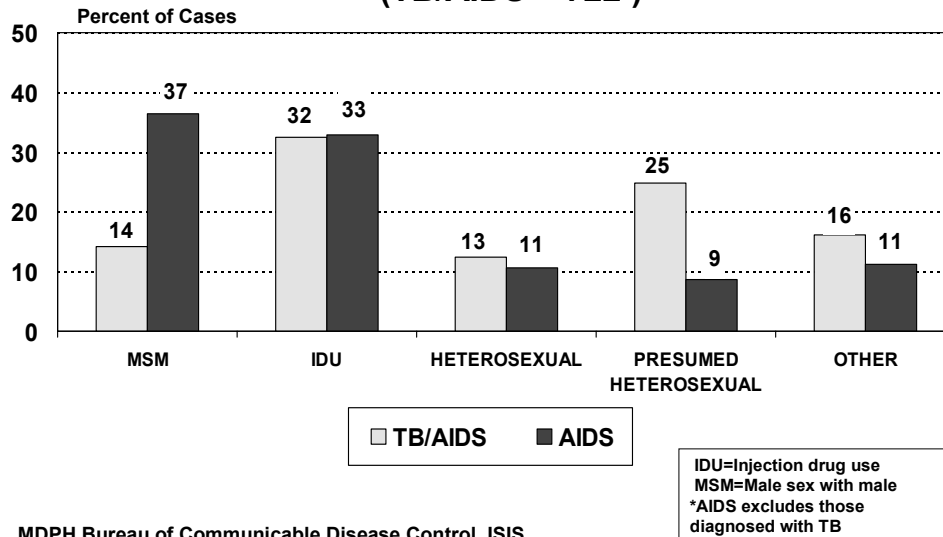


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Among all reported TB/AIDS cases, the most common reported risk for acquiring HIV infection was injecting drug use (234, 32%) followed by presumed heterosexual contact (179, 25%), men who have sex with men (102, 14%) and heterosexual contact with someone known to be infected or at risk (90, 13%). Compared to AIDS cases, a greater proportion of TB/AIDS cases contracted HIV infection through presumed heterosexual contact (25% vs. 9%).

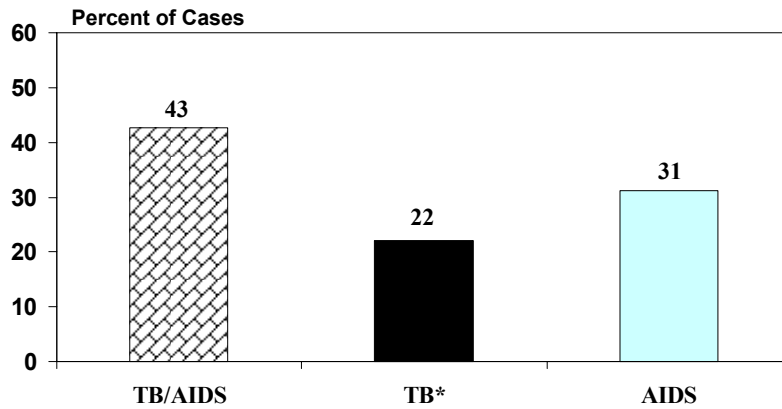
Note: Heterosexual risk is defined as sexual contact with someone of the opposite sex who is known to be HIV infected or to be at risk for HIV infection. Presumed heterosexual contact is defined as an individual with no other reported risk who has sexual partners of unknown HIV or risk status.

**Figure 34. Percent of TB/AIDS and AIDS\* Cases by HIV Transmission Category  
Massachusetts, 1982 – 2007  
(TB/AIDS = 722 )**



At time of AIDS diagnosis, 43% of the TB/AIDS cases resided in the City of Boston as compared to 22% of the TB cases and 31% of the AIDS cases.

**Figure 37. Proportion of TB/AIDS Cases Residing in Boston \* Massachusetts, 1982 – 2007  
(TB/AIDS = 722)**



MDPH Bureau of Communicable Disease Control, ISIS

\*Residence at time of AIDS diagnosis  
\*\*TB Cases as of 2007